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Carcass and meat quality characteristics of designated indigenous sheep breeds of India

A R SEN[1] and S A KARIM[2]

Central Sheep and Wool Research Institute, Avikanagar, Rajasthan 304501 India

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ABSTRACT

Carcass and meat quality traits of 18 lambs of indigenous breeds, viz. Malpura, Garole and Malpura × Garole were analyzed. The pre-slaughter weight was significantly lower in Garole as compared to Malpura and their crosses. The small size Garole had significantly higher dressing yield as compared to large size Malpura. The muscular development as indicated by loin eye area was higher in the Malpura and crossbred lambs as compared to Garole. Differences among the breeds for the proportion of wholesale cuts as a percentage in half carcass tended to be small and mostly nonsignificant. In all the breeds, the leg cut had highest lean content. In the neck region, a significant higher bone content was observed in the large size Malpura as compared to smaller size Garole. Cooking loss percentage was significantly lower in Garole sheep as compared to Malpura and their crosses. The water holding capacity (WHC) is significantly more in Garole rams. Tenderness and juiciness was rated better in Garole and their crossbreds than Malpura. In organoleptic study overall score was ranked in the order of Malpura × Garole>Garole>Malpura. The current study showed that carcass and meat quality of Garole was similar to Malpura or their crossbreds. It was also evident that the overall meat quality was better in Garole compared to Malpura rams.

Key words: Carcass, Lambs, Meat quality, mutton

The evaluation of carcass traits of indigenous sheep is essential both for developing appropriate breeding strategy as well as for recommending breed of sheep for meat production. Malpura is a large size dominant breed of sheep in Rajasthan while Garole sheep is indigenous to Sunderban area of West Bengal, India, and is known for higher prolificacy. The two breeds differ markedly in mature body size. Many studies have analyzed the effect of breed and slaughter weight on the physicochemical characteristics of lamb meat (Perez *et al.* 2002, Macit *et al.* 2002, Hoffman *et al.* 2003, Martinez-Cerezo *et al.* 2005, Muthukumar *et al.* 2006).

Amount and site of fat in the carcass influences its quality and such relationship between carcass weight and fat content was recognized by Okeudo and Moss (2005). Meat tenderness and flavour appear to be the most important sensory characteristics that determine meat quality (Shahidi *et al.* 1986, Sanudo *et al.* 1996).

Some reports have appeared on carcass study of Indian indigenous breed Malpura (Basuthakur *et al.* 1980), Avikalin (Prasad *et al.* 1981) while comparative study on carcass and meat quality of different indigenous sheep breeds and their crosses with variable adult weight was limited. This study was designed mainly to investigate the efficiency of Garole sheep as a meat producing breed and to characterize the effect of breed on the carcass and chemical composition as well as sensory characteristics of meat obtained from designated indigenous sheep breed.

Present address: [1]Principal Scientist, NRC on Meat, Chengicherla, P.B.No.19, Uppal P.O. Hyderabad, Andhra Pradesh 500 039.(e mail: senarup@rediffmail.com).

[2]Director.

MATERIALS AND METHODS

The experiment was conducted at the Central Sheep and Wool Research Institute, Avikanagar, Rajasthan, India, located at 75°28′E latitude and 26°17′N longitude and 320 m above mean sea level. The climate of the location is classified as hot and semi-arid.

Male lambs (6) from each breed (Malpura, Garole and Malpura×Garole) were used in this study. Crossbreeding of Malpura ewes with Garole rams was attempted with the view to infuse the genes responsible for prolificacy into crossbreds. The lambs were let out in the pasture at 0800 hours and grazed for 8 h under supervision of a grazer followed by herding in a side open animal shed till next day morning. The grazing area was dominated by *Cenchrus ciliaris* (70%) with seasonal shrubs and forbs constituting the other vegetation. Besides

grazing, all the animals were offered 250 g concentrate/head/day.

All the animals were slaughtered at 10 months of age. The lambs were fasted over night with free access to water and slaughtered in the experimental abattoir by Halal method. After slaughter, the head was removed at the atlanto-occipital joint and fore and hind feet removed at the carpal and tarsal joints, respectively. The animals were partially skinned lying on their back on the floor. Then the animals were suspended by the hind legs for further skinning. Carcass and non-carcass components were separated immediately after slaughter and recorded and were chilled at 4°C. Lungs, trachea and heart were weighed as one piece and designated as the pluck.

Non-carcass components included head, skin, feet, digestive tract, liver, spleen, pancreas, lungs plus trachea. Weight of digestive contents was computed as the difference between full and empty digestive tracts. The empty live weight (ELW) was computed as the difference between slaughter weight and weight of digestive content. Carcass was split along the middle and the left half was cut into leg, loin, rack, neck and shoulder and breast and foreshank as per ISI (1963) specifications. The cuts were dissected into lean, bone and fat (subcutaneous and intermuscular) after overnight chilling. The per cent composition of the cuts was calculated on the basis of chilled carcass weight. Loin eye area (cm^2) was recorded on the cut surface of *Longissimus dorsi* muscle at the interface of 12th and 13th rib on both side of the carcass.

Longissimus dorsi was collected and analyzed for meat quality evaluation. Cooking loss% was determined by weight loss after cooking of meat for 1 h in water bath at 80°C (Babiker *et al.* 1990). Shear force value of cooked meat samples was determined using Warner Bratzler shear press and Water holding capacity (WHC) was estimated by filter paper pressing technique in screw plates (Trout 1988). The sensory evaluation for color, odour, tenderness, juiciness and overall palatability was performed by a semi-trained panel using 6 point scale (6 = excellent, 1= very poor).

Statistical analysis of results were done using SPSS statistical software 12.0 version (SPSS 2003). Data were analysed using one way analysis of variance (ANOVA) to test for the effect of breed. Significant group differences were compared by Duncan's Multiple Range Test (Duncan 1955).

RESULTS AND DISCUSSION

Carcass characteristics

The pre-slaughter weight was significantly (P<0.01) lower in Garole as compared to Malpura and their crosses (Table 1). In Malpura male lambs the dressing yield was approximately 38% of the live weight while Basuthakur *et al.* (1980) reported higher dressing yield, which could be ascribed to variations in fasting protocol. Interestingly, the small sized Garole rams had significantly (P<0.05) higher dressing yield as compared to Malpura. The lower proportion of non-carcass component mainly alimentary canal and ingesta content in Garole rams contributed to the higher dressing out percentage of the breed. The carcass studies showed high empty body weight percentages and commercial dressing percentages and these characteristics varied only for slaughter weight (Perez *et al.* 2002). The skin yield of Malpura is higher than that of Garole and their crosses. The smaller sheep Garole had proportionally larger head and cannons than Malpura.

Table 1. Carcass traits of Malpura, Garole and their crosses

Traits	Breed		
	Malpura	Garole	Malpura × Garole
Pre-slaughter weight** (kg)	21.18^{a}±0.42	9.10^{b}±0.90	20.68^{a}±0.53
Forequarter weight** (kg)	4.38^{a}±0.12	1.99^{b}±0.21	4.62^{a}±0.14
Hindquarter weight** (kg)	3.71^{a}±0.14	1.62^{b}±0.22	3.94^{a}±0.09
Dressing% (LW)	37.71^{b}±0.60	39.59^{a}±081	41.41^{a}±0.78
Dressing% (ELW)	47.44^{bc}±0.59	46.31^{b}±1.00	50.24^{a}±0.65
Blood%	4.47±0.24	4.19±0.69	3.98±0.15
Skin%	9.69±0.43	7.65±1.55	8.55±0.45
Alimentary canal%	30.07^{a}±1.00	25.31^{b}±0.30	26.70^{b}±0.64
Ingesta%	20.49^{a}±1.05	14.50^{c}±0.10	17.58^{b}±0.68
Kidney fat%	0.25^{b}±0.02	0.29^{a}±0.08	010^{c}±0.02
Caul fat%	0.31^{a}±0.04	0.32^{a}±0.08	0.18^{b}±0.04
Head & cannon%	9.39^{b}±0.14	12.00^{a}±0.20	9.52^{b}±0.31
Pluck%	2.58±0.17	2.84±0.33	2.55±0.09
Liver%	1.90±0.08	2.37±0.37	1.80±0.08
Spleen%	0.32±0.03	0.45±0.04	0.35±0.01
Loin eye area (cm^2)	7.90^{b}±0.49	4.98^{c}±0.47	9.22^{a}±0.27

** P<0.01, means with different superscripts in a row differ significantly (P<0.05); n=6 for each breed.

In general non- carcass fat depot was higher in Garole than Malpura and crossbred, which would indicate that Garole breed can sustain larger period of feed deprivation (Farid 1991). As more fat deposited in the kidney of Garole rams, here we can infer one thing that it is the hardiest among the breeds in the study and is able to survive the long periods of feed shortage during summer. High body fat provides the sheep with the ability to cope with long periods of energy shortage, while low subcutaneous fat cover helps the animals to easily regulate their body temperature in hot environments. Further crossbred lambs (Malpura × Garole) had lower visceral fat (kidney and caul). From the strictly applied viewpoint, any attempt to reduce body fat through crossbreeding or selection may have a negative effect on adaptability of these native breeds to its natural habitat and thus should be accompanied by corresponding improvements in its nutrition and management. The muscular development as indicated by loin eye area was higher in the Malpura and crossbred lambs as compared to Garole.

Table 2. Primal and retail cut yields of Malpura, Garole and their crosses

Traits	Breed		
	Malpura	Garole	Malpura × Garole
Leg%	33.0±0.43	32.66±0.35	32.32±0.31
Loin%	11.29±0.41	12.21±0.41	12.18±0.35
Rack%	12.97±0.37	12.83±0.21	13.0±0.52
Neck and shoulder%	24.59±0.29	25.56±1.77	24.22±0.92
Breast and fores hank%	18.15±0.31	16.99±1.46	18.23±0.69
Total separable Lean%	69.91±1.08	71.39±2.11	69.12±0.10
Fat%	6.55^{b}±0.90	5.73^{b}±0.98	8.95^{a}±0.60
Bone%	23.37±1.81	23.02±.1.26	22.08±1.15

Means with different superscripts in a row differ significantly (P<0.05); n=6 for each breed.

The data on primal cuts and total separable lean, fat and bone content of different breeds is presented in Table 2. The proportions of various primal cuts observed in this study are in close agreement with the observation of Sen *et al.* (2000). Differences among the breed for the proportion of wholesale cuts as a percentage in half carcass tended to be small and mostly nonsignificant. Total separable carcass fat content was lower in Garole as compared to Malpura and crossbred. Accordingly the meat production from Garole sheep is economical due to the higher feed conversion efficiency. Further, modern consumers are more concerned with low fat diet and prefer lean meat.

Table 3. Lean, fat, bone content in different primal cuts of Malpura, Garole and their crosses

Traits		Breed		
		Malpura	Garole	Malpura × Garole
Leg	Lean	75.39±2.11	73.50±1.50	75.63±0.89
	Fat	3.39±0.48	4.40±0.66	5.58±1.24
	Bone	20.04±2.43	19.85±0.15	18.07±2.15
Loin	Lean	74.79^{a}±3.70	66.90^{b}±1.10	61.97^{b}±4.07
	Fat	10.54^{b}±0.67	13.90^{b}±1.89	19.85^{a}±0.90
	Bone	14.99±3.29	15.90±0.10	16.19±4.86
Rack	Lean	66.53±3.26	59.42±4.41	68.32±0.55
	Fat	4.11±1.20	4.63±0.37	7.96±3.52
	Bone	27.64±3.73	34.90±5.10	21.24±3.20
Neck and shoulder	Lean	64.60^{b}±14.79	72.09^{a}±0.83	69.49^{b}±1.16
	Fat	6.84±1.17	4.39±0.21	7.15±0.63
	Bone	28.05^{a}±4.33	21.91^{b}±1.07	21.98^{b}±0.24
Breast and fores hank	Lean	61.12±3.02	63.17±4.83	62.28±4.39
	Fat	11.09±2.61	5.55±2.78	10.22±2.94
	Bone	25.45±2.18	27.25±1.92	26.54±1.09

Means with different superscripts in a row differ significantly (P<0.05); n=6 for each breed.

Breed-wise composition of different cuts is presented in Table 3. Loin ranked the highest among the cuts for percentage of fat. The highest fat content in the loin region was obtained in Malpura × Garole than Malupra and Garole lambs. In all the breeds, the leg cut had highest lean content. In the neck region, a significant (P<0.05) higher bone content was observed in the large sized Malpura as compared to smaller sized Garole rams, while the lean content followed the reverse order. Hogg *et al.* (1992) explained that the difference in fat content and consequently of bone and meat of different joints is a reflection of the pattern of fat deposition and stage of maturity of the animal.

Meat quality attributes

Cooking loss% was significantly (P<0.05) lower in Garole sheep as compared to Malpura and their crosses. The water holding capacity (WHC) was significantly (P<0.05) more in Garole rams. The lower cooking loss% in Garole may be attributed to the higher water holding capacity. Meat with lower WHC, water will be expelled in higher quantity and higher cooking loss% (Vergara *et al.* 1999). It is interesting to note that shear force value was higher in Malpura rams compared to Garole and Malpura × Garole. Generally, shear force values that exceed 5.5 kg would be considered as objectionably tough both by a trained sensory panel and by consumers (Shackelford *et al.* 1991). Hence, meat from Malpura rams was mostly tougher. Warner *et al.* (1990) reported that samples of meat from aged wether sheep with Warner Bratzler shear force values of >6.6 are perceived by taste panel to be tough.

Sensory characteristics of meat from different breeds are presented in Table 4. Colour-wise meat from Malpura × Garole was more attractive than that from Malpura and Garole. Tenderness and juiciness was rated better in Garole and their crossbreds than Malpura. In organoleptic study overall score was ranked in the order of Malpura × Garole>Garole>Malpura.

The current study showed that carcass and meat quality

Table 4. Organoleptic characteristics of meat from Malpura, Garole and their crosses.

Traits	Breed		
	Malpura	Garole	Malpura × Garole
Colour	3.57^{b}±0.20	3.14^{b}±0.34	4.28^{a}±0.18
Odour	3.28±0.18	3.57±0.29	4.42±0.20
Tenderness	3.42^{b}±0.20	4.14^{a}±0.26	4.42^{a}±0.02
Juiciness	3.42^{b}±0.20	4.00^{a}±0.31	4.42^{a}±0.20
Overall palatability	3.14^{b}±0.14	3.57^{b}±0.20	4.43^{a}±0.20

Means with different superscripts in a row differ significantly (P<0.05); n=8 for each sensory traits.

of Garole was similar to Malpura or their crossbreds. It was also evident that the overall meat quality was better in Garole compared to Malpura rams. Therefore, Garole which is a very prolific breed, can be crossbred with Malpura to get better returns for the farmers and at the same time consumers will get better quality meat.

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